# Revanth Krishna Senthilkumaran

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## Research Statement

I aspire to obtain a Doctorate of Philosophy in Robotics. Having worked with various kinds of field robots and with implementing different robot learning algorithms, I have acquired a liking to deeply understand and investigate areas such as perception, human-robot interaction, aerial robotics and reinforcement learning. I seek to work with a laboratory where I can explore these interests and contribute actively to real-world problems in robotics.

## Education

- **Purdue University** West Lafayette, IN
  ***Senior (4th Year)**, Bachelor of Science in Computer Engineering; GPA: 3.59/4.00* *Aug 2021 – May 2025*
  - **Relevant Coursework**: ECE 56900*: **Robotics**, ECE 57000*: **Artificial Intelligence**, ECE 49595: **Reinforcement Learning**, ECE 36200: Microprocessor Systems & Interfacing, ECE 36800: Data Structures, ECE 43700: Comp. Architecture & Prototyping, ECE 39595: Object Oriented Programming in C++, ECE 30200 Probablistic Methods, ECE 20875: Python for Data Science
    ( * - Graduate level classes )

## Research Experience

- **IDEAS Laboratory** West Lafayette, IN
  *Undergraduate Research Assistant* *Sep 2023 - **Present***
  - **Persistent Monitoring**: Currently working on a robotics persistent monitoring project with a spatio-temporal attention network. Seeking to setup a simulator and work with field robots such as UAVs and quadrupeds.
  - **Meta Project Aria**: Also currently working on using Meta's Project Aria glasses towards a project to collect and train egocentric data tasks for human-robot interaction.
  - **ARTEMIS**: Used a Unitree Go1 quadrupedal robot with color and depth cameras to demonstrate capability of robots to assist first-responders with AI-based triage labeling trained using a medical center ED dataset. *Paper submitted to IEEE-ICRA 2025.*
- **Robotics, Perception and Manipulation Laboratory** Minneapolis, MN
  *Undergraduate Research Assistant* *Jun 2023 - Aug 2023*
  - **Quadruped Furniture Manipulation**: Developed new method of robust data collection using Boston Dynamics robot quadruped Spot for learning from demonstration on domestic furniture manipulation tasks with language commands for a vision-language model (Per-Act). Project involved Python, ROS, Simulation, Camera Transformations, Voxels, Boston Dynamics API.
- **SMART Laboratory** West Lafayette, IN
  *Undergraduate Research Assistant* *Feb 2022 - Aug 2023*
  - **UPPLIED**: Established novel method of using UAVs to inspect surfaces autonomously with learning from expert demonstration. ***PUBLISHED*** to *IEEE-IROS 2023*. Used WeBots for simulation environment, ROS and VICON camera system to perform real world experiments.
  - **MOCAS Dataset and SMARTmBOT**: **MOCAS** Dataset - mobile robot SMARTmBOT used to create a multimodal dataset with user studies for simultaneous cognitive workload assessment. ***PUBLISHED*** in *IEEE-TAFFC 2024 JOURNAL*. SMARTmBOT paper **SUBMITTED** to *IEEE-IROS 2022*.
- **Air Force Research Laboratory** West Lafayette, IN
  *Undergraduate Researcher* *Aug 2022 - May 2023*
  - **Team Lead, NXP HoverGames3**: Led a team of students to compete in the NXP HoverGames3 UAV sustainability contest. Coordinated with the Horticulture department and proposed a method of using a drone with an RGB-depth camera to investigate and inspect lettuce plants grown on vertical farming, including shades of green, water content and gas sensing.
  - **IEEE Autonomous UAV Challenge 2023**: Worked with rover-tracking team to use a UAV to compete in a challenge, where a UAV tracks and follows a ground rover through obstacles.

## Work Experience

- **AeroVironment Inc.** Moorpark, CA
  *Software Engineering Intern, MacCready Works R&D Division* *Jun 2024 - Aug 2024*
  - **Internship**: Implemented working autonomous software stack actively deployed on fixed wing UAV to a quadcopter to show hardware agnostic feature of stack. Set up robotics simulation with Gazebo, and wrote PX4 bridge with BehaviorTree XML capability. Wrote a ROS2 PX4 bridge to send surveillance and mapping missions with BehaviorTree XMLs.
- **School of Electrical and Computer Engineering, Purdue University** West Lafayette, IN
  *Undergraduate Teaching Assistant* *Aug 2024 - Present*
  - **ECE 20875: Python for Data Science**: Assisting students in intro to Python and Data Science for ECE majors class. Many data science concepts, machine learning and deep learning methodologies are introduced. My duties included helping students with homeworks and labs, teaching concepts from class and proctoring exams.
- **The Autonomous Robotics Club of Purdue** West Lafayette, IN
  *President, Fmr. Vice President, Fmr. Project Manager of Piano Hand* *Jul 2021 - Present*
  - **President**: Representing largest robotics club of Purdue: duties incl. councils for funding pitches, networking, club collaborations, workshops and seminars. Leading America's largest student-run robotics expo, RISE.
  - **Piano Hand**: Founded team to build an autonomous human-like hand that can read sheet music and play the piano. Setup ROS simulation, electronics, micro-controllers, hardware and algorithms teams.
- **Bechtel Innovation Design Center, Purdue University** West Lafayette, IN
  *Printing and Prototyping Peer Mentor* *Feb 2023 - Sep 2024*
  - **Makerspace**: Working with over 800 students every semester for projects with Metal and Non-metal Laser Cutting, 3D Printing: SLA, SLS, Carbon-fiber reinforced Onyx and resin, along with many personal projects. Also explored additional research projects, such as identifying appropriate methods to glue acrylic together.

## Papers and Publications

(* indicates equal contribution)

- **ARTEMIS: AI-Driven Robotic Triage Labeling and Emergency Information System**
  ***RK Senthilkumaran**, M Prashanth, H Viswanath, S Kotha, K Tiwari, A Bera* *2024*
  - **About**: AI-driven robotic system for victim localization and severity assessment in mass casualty incidents. Utilized speech and natural language processing, and deep learning for acuity classification, deployed on Unitree Go1 quadruped robot.
  - **IEEE-ICRA 2025**: Paper SUBMITTED to IEEE-ICRA 2025.
- **UPPLIED: UAV Path Planning for Learning from Demonstration**
  *SS Kannan*, VLN Venkatesh*, **RK Senthilkumaran**, BC Min* *2023*
  - **About**: Novel path-planning framework for UAV-based visual inspection of large structures. Leveraged demonstrated trajectories to generate new, optimized paths for inspecting similar structures, maintaining geometric consistency and focus on targeted regions. Demonstrated adaptability across different structures with minimal deviation through various experiments.
  - **IEEE-IROS 2023**: Paper PUBLISHED in IEEE-IROS 2023. Attended and presented poster with co-authors.
- **A Multimodal Dataset for Objective Cognitive Workload Assessment on Simultaneous Tasks**
  *W Jo*, R Wang*, S Sun, **RK Senthilkumaran**, D Foti, BC Min* *2022*
  - **About**: Realistic, multimodal dataset for assessing human cognitive workload derived from actual CCTV monitoring tasks. Integrated physiological and behavioral data from wearable sensors and webcam, collected from 21 participants, including CWL self-assessments and personal background surveys. Mobile multi-robot system, SMARTmBOT used in experiments. Validated effectiveness in eliciting varied cognitive workload levels, providing a valuable tool for real-world CWL recognition.
  - **IEEE-TAffC 2024**: Paper PUBLISHED in IEEE-TAffC 2024.
- **SMARTmBOT: A ROS2-based Low-cost and Open-source Mobile Robot Platform**
  *W Jo, J Kim, R Wang, J Pan, **RK Senthilkumaran**, BC Min* *2022*
  - **About**: Presented SMARTmBOT, an affordable, open-source mobile robot platform for robotics research and education, built on ROS2. Features low-cost, modular, customizable, and expandable design with most components 3D-printable and total cost around $210. Demonstrated capabilities through diverse experiments; source code available on GitHub for sensor integration, camera streaming, and robot control.
  - **IEEE-IROS 2022**: Paper SUBMITTED to IEEE-IROS 2022

## Presentations

All papers and publications mentioned in the previous section were also presented in research conferences and expos accordingly.

- **Data Collection for Mobile Manipulators for Learning from Demonstration**
  *University of Minnesota Summer Undergraduate Research Conference* *2023*
  - **About**: Developed a data collection method using Boston Dynamics Spot's advanced hardware and behaviors for robot learning through task demonstrations. Created voxel maps encompassing robot state and goal information, fed into a modified Vision-Language Model, Per-Act, for training. Compiled a dataset of around 25 varied demonstrations with Spot, emphasizing practical application of robotic manipulation and navigation.
- **VF-PLUME: Vertical Farming Plant Localizing UAV with Mass Estimation**
  *Purdue Spring Undergraduate Research Conference* *2023*
  - **About**: Introduced a UAV equipped to assess plant growth and environmental conditions in compact vertical farms. Utilized advanced localization algorithms and environmental sensors to create detailed 3D maps capturing data like temperature, humidity, and air quality.
- **A Dynamic Cognitive Workload Allocation Method for Human Robot Interaction**
  *Purdue Fall Undergraduate Research Conference* *2022*
  - **About**: Explored dynamic allocation and measurement of cognitive workload in HRI using novel workload allocation and affective prediction algorithms. Leveraged 'Husformer,' a multi-modal framework with cross-modal transformers, analyzing data from biosensors and behavioral sensors. Validated effectiveness through user experiments, optimizing task allocation based on individual cognitive load.
- **A GUI for Measuring Cognitive Workload Stimulus in Human Robot Interaction**
  *Purdue Spring Undergraduate Research Conference* *2022*
  - **About**: Introduced a new GUI-based method to assess cognitive stimulus in HRI, replacing outdated tools like Dual N-Back. Conducted study with 30 participants interacting with SMARTmBOTs and using wearable biosensors, data integrated into a multi-modal perception model. GUI developed using PyQt for ROS2 compatibility, made open source for broader application in HRI research.

## Skills

**Languages**: Python, C++, C, Assembly, Verilog, SQL, MarkDown, HTML, CSS, JavaScript
**Technologies**: Git, ROS, Linux, Docker, MATLAB, Arduino/ESP, Raspberry Pi
**Research**: LaTeX, User Studies, Presentations

## Volunteering

- **Boiler Gold Rush Team Leader** Purdue University
  *Student Orientation Leader* *Aug 2022*
  - **Team Leadership**: Led a group of 15 incoming freshmen, guiding them through campus tours, conducting events, and teaching essential skills for university life. Facilitated group discussions and provided mentorship on academic and personal development.
- **Community Teaching** G. K. Jain Schools, Chennai, India
  *Volunteer Instructor* *Summers 2018 – 2021*
  - **Education Outreach**: Taught underprivileged children in Chennai, India, focusing on debate, Model United Nations, and public speaking. Aimed to enhance their communication skills and confidence through interactive sessions and workshops. Students entered and won prizes in first debate and public speaking competition upon my instruction, which was a proud moment as an instructor.

## Awards and Scholarships

**Eli Shay Scholarship in ECE** - 2024-2025
**Dean's List and Semester Honors** - 2021-2024
**2nd Place in College of Science, 2024 Spring Undergraduate Research Conference** - Gave research talk on "ARTEMIS: AI-driven Robotic Triage-labeling and Emergency Information System"
**Summer Internship Plus Scholarship** - 2023
**3rd Place in Interdisciplinary Category, 2022 Spring Undergraduate Research Conference** - Gave research talk on "A GUI for Measuring Cognitive Workload Stimulus in Human Robot Interaction"
**Best Data Visualization**, ASA DataFest 2022